CLAIMS

1. A method of hydrogenating an unsaturated feedstock, comprising:
producing a catalyst composition by heating a nickel-based catalyst to a first temperature of at least about 85° C in the presence of a process gas and a protective non-gas medium; and, thereafter,
contacting the unsaturated feedstock with the catalyst composition and hydrogenating the unsaturated feedstock by sustaining a hydrogenation reaction at a second temperature of no greater than about 70° C, the feedstock comprising at least one unsaturated organic component.

2. The method of claim 1 wherein the protective non-gas medium comprises a fat component.

3. The method of claim 1 wherein the protective non-gas medium comprises a liquid.

4. The method of claim 1 wherein the protective non-gas medium is no less solid than semi-solid at about 25° C..

5. The method of claim 1 wherein the process gas comprises a substantially non-oxidizing gas.

6. The method of claim 1 wherein the process gas comprises hydrogen.

7. The method of claim 1 wherein the process gas comprises nitrogen.

8. The method of claim 1 wherein the second temperature is no greater than about 60° C.

9. The method of claim 1 wherein the second temperature is no greater than about 50° C.

10. The method of claim 1 wherein the second temperature is about 0-60° C.

11. The method of claim 1 wherein the second temperature is about 20-50° C

12. The method of claim 1 wherein the second temperature changes over the course of the hydrogenation reaction, the hydrogenation reaction being initiated at a second temperature no greater than about 60° C.

13. The method of claim 1 wherein the second temperature changes over the course of the hydrogenation reaction, the hydrogenation reaction being initiated at a second temperature no greater than about 60° C, the hydrogenation reaction being completed without exceeding about 70° C.

14. The method of claim 1 wherein the hydrogenation reaction at the second temperature changes an Iodine Value of the feedstock, the Iodine Value changing at an average rate of no less than about 5/hour.

15. The method of claim 1 wherein the hydrogenation reaction at the second temperature changes an Iodine Value of the feedstock, the Iodine Value changing at an average rate of about 6-60/hour.

16. The method of claim 1 wherein the hydrogenation reaction at the second temperature changes an Iodine Value of the feedstock, the Iodine Value changing at an average rate of about 10-40/hour.

17. The method of claim 1 wherein hydrogenating the unsaturated feedstock includes delivering a hydrogenation gas to the feedstock, the hydrogenation gas consisting essentially of hydrogen.

18. The method of claim 1 wherein the nickel-based catalyst composition has a total nickel content of about 2-50 weight percent.

19. The method of claim 1 wherein the nickel-based catalyst composition has a total nickel content of about 2-50 weight percent, and nickel comprises no more than about 1 weight percent of the combined unsaturated feedstock and catalyst composition.

20. The method of claim 1 wherein the nickel-based catalyst is dispersed in the protective non-gas medium, the protective non-gas medium comprising a fat component that is solid at room temperature and liquid at the first temperature.

21. The method of claim 1 wherein the nickel-based catalyst is dispersed in the protective non-gas medium, the protective non-gas medium comprising a fat component that is no more solid than semi-liquid at room temperature and liquid at the first temperature.

22. The method of claim 1 wherein contacting the unsaturated feedstock with the catalyst composition comprises dispersing the nickel-based catalyst in the unsaturated feedstock.

23. The method of claim 1 wherein the feedstock comprises an oil and the at least one unsaturated organic component comprises a polyunsaturated fatty acid.

24. The method of claim 1 wherein the at least one unsaturated organic component comprises at least one compound selected from the group consisting of unsaturated aliphatic compounds, unsaturated aromatic compounds, and unsaturated heterocyclic compounds.

25. The method of claim 1 wherein the protective non-gas medium comprises a triglyceride oil.

26. The method of claim 1 wherein the protective non-gas medium comprises a fat component that forms a fat matrix of the catalyst composition that has a melting point that is higher than the second temperature.

27. The method of claim 1 wherein the protective non-gas medium comprises a fat component that forms a fat matrix of the catalyst composition that has a melting point that is no higher than the second temperature.

28. The method of claim 1 wherein the protective non-gas medium comprises a fat component and producing the catalyst composition includes hydrogenating the

fat component, the catalyst composition comprising an activated catalyst dispersed in a hydrogenated fat matrix.

29. The method of claim 28 wherein the hydrogenated fat matrix has a melting point that is higher than the second temperature.

30. The method of claim 1 wherein the protective non-gas medium comprises a fat component that forms a fat matrix of the catalyst composition that has a melting point that is higher than the second temperature, and wherein the catalyst composition is at a temperature at least as high as the melting point when added to the feedstock.

31. The method of claim 1 further comprising introducing hydrogen into the feedstock before adding the catalyst composition.

32. The method of claim 1 wherein the catalyst composition is substantially the only catalyst source during the hydrogenation of the feedstock.

33. The method of claim 1 wherein hydrogenating the unsaturated feedstock produces a hydrogenated feedstock, further comprising cooling the hydrogenated feedstock from the second temperature to a third temperature under a hydrogen atmosphere.

34. The method of claim 1 wherein hydrogenating the unsaturated feedstock produces a hydrogenated feedstock, further comprising cooling the hydrogenated feedstock from the second temperature to a third temperature of no greater than about 35° C under a hydrogen atmosphere.

35. A method of hydrogenating an unsaturated oil having an initial Iodine Value and an initial fatty acid content including at least about 4 weight percent C18:3, the method comprising:

dispersing a nickel-based catalyst in the oil;

delivering hydrogen to the oil; and

hydrogenating the oil at a hydrogenation temperature no greater than about 75° C for a hydrogenation time to yield a hydrogenated oil having a modified Iodine Value and including a modified fatty acid content, wherein the hydrogenated oil is no more solid than semi-liquid at 25° C, an absolute difference between the initial Iodine Value and the modified Iodine Value divided by the hydrogenation time defines an average Iodine Value change rate of no less than about 5/hour, no more than about 2.5% of the modified fatty acid content comprises C18:3, and no more than about 6% of the modified fatty acid content comprises *trans*-fatty acids.

36. The method of claim 35 wherein the oil is at the hydrogenation temperature when initiating the hydrogenation and the oil is hydrogenated without adding external heat.

37. The method of claim 35 wherein hydrogen is delivered to the oil before dispersing the nickel-based catalyst in the oil.

38. The method of claim 35 wherein the nickel-based catalyst is included in a catalyst composition that also comprises a fat matrix.

39. The method of claim 38 wherein dispersing the nickel-based catalyst comprises melting the fat matrix.

40. The method of claim 38 wherein the fat matrix has a melting point that is higher than the hydrogenation temperature.

41. The method of claim 38 wherein the fat matrix has a melting point that is no higher than the hydrogenation temperature.

42. The method of claim 35 wherein nickel comprises no more than about 1 weight percent of the combined oil and nickel-based catalyst.

43. The method of claim 35 wherein the hydrogenation temperature is no greater than about 60° C.

44. The method of claim 35 wherein the second temperature is no greater than about 50° C.

45. The method of claim 35 wherein the second temperature is about 0-60° C.

46. The method of claim 35 wherein the hydrogenation temperature is about 20-50° C.

47. The method of claim 35 wherein the hydrogenation temperature changes over the course of the hydrogenation time, the hydrogenation reaction being initiated at a hydrogenation temperature no greater than about 60° C.

48. The method of claim 35 wherein the hydrogenation temperature changes over the course of the hydrogenation time, the hydrogenation reaction being initiated at a hydrogenation temperature no greater than about 60° C and the hydrogenation temperature not exceeding about 70° C during the hydrogenation time.

49. The method of claim 35 wherein the average Iodine Value change rate is between about 6/hour and about 60/hour.

50. The method of claim 35 wherein the average Iodine Value change rate is between about 10/hour and about 40/hour.

51. The method of claim 35 wherein delivering hydrogen to the oil comprises delivering a gas consisting essentially of hydrogen.

52. The method of claim 35 wherein the nickel-based catalyst is substantially the only catalyst source during the hydrogenation of the oil.

53. The method of claim 35 further comprising cooling the hydrogenated oil from the hydrogenation temperature under a hydrogen atmosphere.

54. The method of claim 35 further comprising cooling the partially hydrogenated feedstock from the second temperature to a third temperature of no greater than about 35° C under a hydrogen atmosphere.

55. A method of hydrogenating an oil having an initial Iodine Value and an initial induction period, the method comprising:
dispersing a nickel-based catalyst in the oil;
delivering hydrogen to the oil; and
hydrogenating the oil at a hydrogenation temperature no greater than about 70° C for a hydrogenation time to yield a hydrogenated oil having a modified Iodine Value and a modified induction period, wherein an absolute difference between the initial Iodine Value and the modified Iodine Value divided by the hydrogenation time defines an average Iodine Value change rate of no less than about 5/hour, and the modified induction period is at least about twice the initial induction period.

56. The method of claim 55 wherein the initial induction period and the modified induction period are measured at about 120° C.

57. The method of claim 55 wherein no more than about 6 weight percent of a total fatty acid content of the hydrogenated oil is *trans*-fatty acid.

58. The method of claim 55 wherein the hydrogenation temperature is about 20-50°C.

59. The method of claim 55 wherein nickel comprises no more than about 1 weight percent of the combined oil and nickel-based catalyst.

60. A substantially platinum-free hydrogenation catalyst composition comprising:
a protective non-gas medium; and
a nickel-based catalyst dispersed in the protective non-gas medium, the nickel-based catalyst being adapted to sustain, at a temperature of about 70° C or less and in the presence of hydrogen, a hydrogenation reaction of a dielectric oil comprising polyunsaturated fatty acids.

61. The hydrogenation catalyst composition of claim 60 wherein the protective non-gas medium is solid at 25° C.

62. The hydrogenation catalyst composition of claim 60 wherein the catalyst composition has a total nickel content of about 2-50 weight percent.

63. The hydrogenation catalyst composition of claim 60 wherein the catalyst composition has a total nickel content of about 2-50 weight percent, the catalyst being adapted to sustain the hydrogenation reaction at the temperature when the nickel comprises no more than about 1 weight percent of the combined oil, nickel-based catalyst, and protective non-gas medium.

64. The hydrogenation catalyst composition of claim 60 wherein the temperature is no greater than about 60° C.

65. The hydrogenation catalyst composition of claim 60 wherein the temperature is no greater than about 50° C.

66. The hydrogenation catalyst composition of claim 60 wherein the temperature is about 0-60° C.

67. The hydrogenation catalyst composition of claim 60 wherein the temperature is about 20-50° C.

68. A substantially platinum-free hydrogenation catalyst composition comprising:
a fat matrix; and
a nickel-based catalyst dispersed in the fat matrix, the nickel-based catalyst being adapted to sustain, at a temperature of about 70° C or less and in the presence of hydrogen, a hydrogenation reaction of a dielectric oil comprising polyunsaturated fatty acids.

69. The hydrogenation catalyst composition of claim 68 wherein the fat matrix is solid at 25° C.

70. The hydrogenation catalyst composition of claim 68 wherein the fat matrix is no more solid than semi-liquid at 25° C.

71. The hydrogenation catalyst composition of claim 68 wherein the fat matrix has a solid fat content of no greater than about 20 weight percent at 25° C.

72. The hydrogenation catalyst composition of claim 68 wherein the catalyst composition has a total nickel content of about 2-50 weight percent.

73. The hydrogenation catalyst composition of claim 68 wherein the catalyst composition has a total nickel content of about 2-50 weight percent, the catalyst being adapted to sustain the hydrogenation reaction at the temperature when the nickel comprises no more than about 1 weight percent of the combined oil, nickel-based catalyst, and fat matrix.

74. The hydrogenation catalyst composition of claim 68 wherein the second temperature is no greater than about 60° C.

75. The hydrogenation catalyst composition of claim 68 wherein the temperature is no greater than 50° C.

76. The hydrogenation catalyst composition of claim 68 wherein the second temperature is about 0-60° C.

77. The hydrogenation catalyst composition of claim 68 wherein the second temperature is about 20-50° C

78. A method of hydrogenating an edible oil having an initial Iodine Value and an initial fatty acid content that includes at least about 4 weight percent C18:3, the method comprising:

providing a catalyst composition including a fat component and a nickel-based catalyst that has been heated to a first temperature in the presence of hydrogen;

dispersing the catalyst composition in the oil;

delivering hydrogen to the oil; and

hydrogenating the oil at a second temperature to yield a hydrogenated oil having a modified Iodine Value and including a modified fatty acid content, wherein:

the second temperature is less than the first temperature;

the hydrogenated oil has a solid fat content of no greater than about 20 weight percent at 25° C;

an absolute difference between the initial Iodine Value and the modified Iodine Value divided by the hydrogenation time defines an average Iodine Value change rate of about 6-40/hour;

no more than about 2 weight percent of the modified fatty acid content comprises C18:3; and

no more than about 5 weight percent of the modified fatty acid content comprises *trans*-fatty acids.

79. The method of claim 78 wherein dispersing the catalyst composition comprises contacting the catalyst composition, which is at a third temperature, with the oil, the third temperature being greater than the second temperature and at least as great as a melting point of the fat composition.

80. The method of claim 79 wherein the third temperature is no greater than the first temperature.

81. The method of claim 79 wherein the edible oil has an initial induction period and the hydrogenated oil has an induction period that is at least twice the initial induction period.

82. An edible hydrogenated fat composition formed by the process of claim 1.

83. The edible hydrogenated fat composition of claim 82 wherein the feedstock comprises an edible oil selected from a group consisting of seed oils, vegetable oils, marine oils, animal oils, and blends of two or more of seed oil, vegetable oil, marine oil, and animal oil.

84. An edible hydrogenated fat composition formed by the process of claim 35.

85. The edible hydrogenated fat composition of claim 84 wherein the oil comprises an edible oil selected from a group consisting of seed oils, vegetable oils, marine oils, animal oils, and blends of two or more of seed oil, vegetable oil, marine oil and animal oil.

86. An edible hydrogenated fat composition formed by the process of claim 55.

87. The edible hydrogenated fat composition of claim 86 wherein the oil comprises an edible oil selected from a group consisting of seed oils, vegetable oils, marine oils, animal oils, and blends of two or more of seed oil, vegetable oil, marine oil, and animal oil.

88. An edible hydrogenated fat composition formed by the process of claim 78.

89. The edible hydrogenated fat composition of claim 88 wherein the oil comprises an edible oil selected from a group consisting of seed oils, vegetable oils, marine oils, animal oils, and blends of two or more of seed oil, vegetable oil, marine oil, and animal oil.

90. A food product comprising water and an emulsion of the edible hydrogenated fat composition of any one of claims 82, 84, 86, and 88.

91. The food product of claim 90 further comprising lecithin.

92. A margarine composition comprising water and the edible hydrogenated fat composition of any one of claims 82, 84, 86, and 88.

93. An ice cream composition comprising water and the edible hydrogenated fat composition of any one of claims 82, 84, 86, and 88.

94. A food product comprising sugar and the edible hydrogenated fat composition of any one of claims 82, 84, 86, and 88.

95. A partially hydrogenated edible oil comprising an oil selected from a group consisting of soybean oil and rapeseed oil, wherein the partially hydrogenated edible oil:
is no more solid than semi-liquid at about 25°C;
has a C18:3 content of no greater than about 2.5 weight percent;
has a *trans*-fatty acid content of no more than about 6 weight percent; and
has a ratio of C18 content to the *trans*-fatty acid content (C18 : TFA) of at least about 1.2.

96. The partially hydrogenated edible oil of claim 95 wherein the oil comprises soybean oil.

97. The partially hydrogenated edible oil of claim 95 wherein the oil comprises rapeseed oil.

98. The partially hydrogenated edible oil of claim 95 wherein the C18 : TFA ratio is at least about 1.5.

99. The partially hydrogenated edible oil of claim 95 wherein the C18 : TFA ratio is at least about 2.

100. The partially hydrogenated edible oil of claim 95 wherein a ratio *cis*- to *trans*-forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) is at least about 9.

101. The partially hydrogenated edible oil of claim 95 wherein a ratio *cis*- to *trans*-forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) is at least about 12.

102. The partially hydrogenated edible oil of claim 95 wherein the oil has a solid fat content of no greater than about 20 weight percent at 25° C.

103. A partially hydrogenated edible oil comprising an oil selected from a group consisting of soybean oil and rapeseed oil, wherein the partially hydrogenated edible oil:
is no more solid than semi-liquid at about 25°C;
has a C18:3 content of no greater than about 2.5 weight percent;

has a *trans*-fatty acid content of no more than about 6 weight percent; and
has a ratio of *cis*- to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) of at least about 6.

104. The partially hydrogenated edible oil of claim 103 wherein the CFA : TFA ratio is at least about 9.

105. The partially hydrogenated edible oil of claim 103 wherein the CFA : TFA ratio is at least about 12.

106. The partially hydrogenated edible oil of claim 103 wherein a ratio of C18 content to the *trans*-fatty acid content (C18 : TFA) is at least about 1.5.

107. The partially hydrogenated edible oil of claim 103 wherein a ratio of C18 content to the *trans*-fatty acid content (C18 : TFA) is at least about 2.

108. The partially hydrogenated edible oil of claim 103 wherein the oil comprises soybean oil.

109. The partially hydrogenated edible oil of claim 103 wherein the oil comprises rapeseed oil.

110. A partially hydrogenated sunflower oil formed from a sunflower oil having a C18:1 content of less than 77 weight percent prior to hydrogenation, wherein the partially hydrogenated sunflower oil:
is no more solid than semi-liquid at about 25°C;
has a ratio of *cis*- to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) of at least about 15;
has a ratio of C18 to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (C18 : TFA) of at least about 1.2; and
an induction period at 120° C of at least about 5 hours.

111. A partially hydrogenated sunflower oil that:
is no more solid than semi-liquid at about 25°C;

has a ratio of *cis*- to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) of at least about 25;

has a ratio of C18 to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (C18 : TFA) of at least about 1.5; and

an induction period at 120° C of at least about 10 hours.

112. A partially hydrogenated palmolein fat that:

is no more solid than semi-liquid at about 25°C;

has a C18:2 content of no greater than about 7 weight percent;

has a *trans*-fatty acid content of no more than about 6 weight percent; and

has a ratio of *cis*- to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) of at least about 6.

113. A partially hydrogenated corn oil that:

is no more solid than semi-liquid at about 25°C;

has a C18:2 content of no greater than about 50 weight percent;

has a *trans*-fatty acid content of no more than about 6 weight percent; and

has a ratio of *cis*- to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) of at least about 15.

114. A food product comprising an emulsion of water and the partially hydrogenated edible oil of any one of claims 95, 103, 110, 111, 112, and 113.

115. The food product of claim 103 further comprising lecithin.

116. A margarine composition comprising water and the partially hydrogenated edible oil of any one of claims 95, 103, 110, 111, 112, and 113.

117. An ice cream composition comprising water and the partially hydrogenated edible oil of any one of claims 95, 103, 110, 111, 112, and 113.

118. A food product comprising sugar and the partially hydrogenated edible oil of any one of claims 95, 103, 110, 111, 112, and 113.